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ANALYSIS OF THE NROTC COST PER COMMISSION

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THESIS

ANALYSIS OF THE NROTC COST PER COMMISSION

by

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Every year, thousands of teenagers join Naval Reserve Officer Training Corps (NROTC) to become naval officers. Midshipmen who receive four-year national scholarships are awarded scholarships to public in-state, public out-of-state, or private colleges and universities. This study uses average tuition cost and attrition rates to calculate the cost per commissioned naval officer. It analyzes the cost of each of the three categories independently and the entire NROTC program cost. Results show that the difference in attrition rates is negligible between school categories, and the cost per commission from private schools and public out-of-state schools is more than twice than from public in-state schools. The model created allows Naval Education Training Command to support decision making on cost reductions within the command.

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ANALYSIS OF THE NROTC COST PER COMMISSION

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Submitted in partial fulfillment of the
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ABSTRACT

Every year, thousands of teenagers join Naval Reserve Officer Training Corps (NROTC) to become naval officers. Midshipmen who receive four-year national scholarships are awarded scholarships to public in-state, public out-of-state, or private colleges and universities. This study uses average tuition cost and attrition rates to calculate the cost per commissioned naval officer. It analyzes the cost of each of the three categories independently and the entire NROTC program cost. Results show that the difference in attrition rates is negligible between school categories, and the cost per commission from private schools and public out-of-state schools is more than twice than from public in-state schools. The model created allows Naval Education Training Command to support decision making on cost reductions within the command.

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LIST OF ACRONYMS AND ABBREVIATIONS

CPC	Cost per commission
CYUS	Ceiling years under scholarship
DUS	Days under scholarship
ENS	Ensign
MIDN	Midshipman
MIDN	Midshipmen
MSO	Military service obligation
NCPR	North Carolina Piedmont Consortium
NCSU	North Carolina State University
NETC	Naval Education Training Command
NROTC	Naval Reserve Officer Training Corps
PIS	Public in-state school
POS	Public out-of-state school
PRI	Private school
UNC	The University of North Carolina at Chapel Hill
USMC	United States Marine Corps
USN	United States Navy
YUS	Years under scholarship

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I. INTRODUCTION

The Naval Reserve Officer Training Corps (NROTC) is a commissioning program of the United States Navy (USN) and the United States Marine Corps (USMC). Attrition from the NROTC program can be extremely costly to the USN. This MBA project examines the costs associated with attrition from the NROTC. Every year, thousands of teenagers join the NROTC in the hopes of eventually commissioning as naval officers. Once part of the NROTC, a portion of these Midshipmen (MIDN) will not make it to commissioning due to academic, personal, or character reasons. The findings will allow the Naval Education Training Command (NETC) to support decision making on cost reductions within the organization.

A. DISCUSSION

In 1926, the Department of the Navy established NROTC at six civilian institutions to produce naval officers. Today, there are 63 NROTC programs at 77 schools throughout the United States. Individuals enter the program within two main categories: 1) with a scholarship or 2) seeking a scholarship after their first or second year of college. Costs to the Navy for those MIDN on scholarship includes tuition (which varies with the school), a $750 annual book stipend, a monthly stipend of $250-$400 (dependent on the MIDN's naval science year) and pay during summer training periods. MIDN on scholarship have until September 1st of their sophomore year to decide if they want to stay in the program. If they drop on request (DOR) before that date, they are not obligated to repay the scholarship and stipends. MIDN who DOR after September 1st of their sophomore year are required to pay back the tuition and fees the Navy has already paid to the school as well as the stipends paid to the MIDN.

Understanding the contribution of each cost component to the overall cost with supporting the NROTC may provide insights that could help NETC better allocate their resources to the applicants and schools that would bring them closer to meeting their mission. Hence, this project aims to examine the cost components associated with each NROTC commission.

B. RESEARCH QUESTIONS

(1) What are the main NROTC costs to the Navy, per commissioned officer?

(2) How do these costs vary by type of school attended, and the tuition regime (in-state or out-of-state)?

(3) How does the attrition in NROTC vary by the type of school attended: public in-state, public out-of-state, and private school?

C. SCOPE

This study used individual data on four-year scholarship recipients who entered the program between 2009 and 2016. Those who attrited from the program were limited to 2012 through 2019 due to the incomplete data within the set. This group of MIDN was chosen because they participated in the same scholarship application process and was subjected to the same criteria. This study excluded the three-year and two-year NROTC scholarship recipients due to the different application process as well as the limitation of receiving a three-year or two-year scholarship to the school where the MIDN is already attending. This study included recipients of both the Navy and Marine Corps National Scholarship; the analysis neither differentiates nor isolates one group of MIDN from the other. Using data provided by Naval Education and Training Command (NETC), the project analyzes the completion rates and cost per commission of four-year National Scholarship MIDN who attend public in-state (PIS), public out-of-state (POS), and private colleges and universities (PRI). The total cost per MIDN included tuition, annual book stipend, and a monthly stipend. The financial costs associated with the project used average costs and are in FY18 dollars.

D. PROJECT PROCESS

In order to answer the research questions, a cost model was developed using personnel data provided by NETC. This data includes four-year National Scholarship MIDN who entered the NROTC program between 2009 and 2016. To calculate an average annual tuition cost, tuition from FY09-FY18 was adjusted using Consumer Price Index (CPI) indices to provide all costs in FY18 dollars. The annual tuition cost was averaged across the years in the data set, to account for the rising or falling cost of tuition across years.

Within the data set, indicator variables were created to take a numerical value of years under scholarship. This allowed for the annual book stipend, monthly MIDN stipend, and tuition paid to the school to be multiplied by years under scholarship to end up with a total cost per MIDN. The book stipend and monthly MIDN stipend is the same for every MIDN regardless of school type or year, while the tuition cost is dependent on the type of school the MIDN attended. All the cost components were added together to formulate a total cost of the four-year scholarship MIDN for the years between 2009 and 2016. This number was then divided by the total number of MIDN who commissioned from the program to calculate a cost per commission. This process was completed three additional times, breaking out the three tuition types to find a cost per commission for PIS, POS, and PRI MIDN respectively.

The computed cost per commission was used in a linear programming model developed as a decision-support tool created to give NETC a decision-making tool to control costs or increase output numbers based on the constraints of the model.

The rest of the project is organized as follows:

Chapter II presents the history and current mission of the NROTC program. It then highlights the process for applying for a NROTC scholarship, the different types of NROTC scholarships, as well as the different financial benefits included within each scholarship.

Chapter III, Literature Review, references the prior studies, which informed the framework of analysis used in this project. To that end, it further compares the similarities and differences of prior studies with the scope of this project.

The next chapter, Chapter IV, covers the Data, Methodology, and Analysis, starting with an overview of the data set, the process of cleaning the data, defining the variables, and an analysis of the data. Using the data analysis results, it then describes the programming model developed to optimize money spent on four-year national scholarship students.

Chapter V, Conclusions and Recommendations, summarizes the main findings from this project's analysis and makes recommendations for further work to increase the scope and/or create a sensitivity analysis using the results found in Chapter IV.

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II. BACKGROUND

The background of the NROTC program includes the history of the NROTC program, the current mission of the program, the application process for the four-year national scholarship, and the financial benefits provided to MIDN. The purpose of this chapter is to inform the reader of the basics of the NROTC scholarship program.

Naval Reserve Officer Training Corps

The Department of the Navy established NROTC in 1926 at six universities throughout the country. Prior to 1926, the only commissioning source for naval officers was the United States Naval Academy. The purpose of NROTC at the time was to allow men to undertake a career in the naval profession and to have a larger pool of reserve officers ready to go in case of the need for a rapid expansion (Naval Education Training Command [NETC], 2020). This mission continued until 1946 when the "Holloway Plan" was passed by Congress.

The Holloway Plan was enacted by Public Law 729 and changed the way naval officers entered the fleet. It broke up the Naval Academy's monopoly by offering MIDN free education at colleges and universities at the government's expense. In return, MIDN acquired a three-year service commitment. Unlike previous versions of NROTC, graduates of the program were able to commission into active duty status and not reserve status. This bill was passed by Congress and signed into law on August 13, 1946 (Pub. L. No 729, 1946).

Today, the current mission of the NROTC program "is to develop young men and women morally, mentally, and physically, and to instill in them the highest ideals of honor, courage, and commitment" (NETC, 2020). The program has continued to expand and is currently the largest source of naval officer commissions. There are 64 ROTC units or consortiums that provide the opportunity to participate in NROTC. A consortium is a group of schools that fall under one command yet operate mostly independently from each other. An example of this is the North Carolina Piedmont Region Consortium (NCPR). NCPR includes three colleges, North Carolina State University (NCSU), Duke University, and the

University of North Carolina at Chapel Hill (UNC). Each university maintains an independent program while engaging with each other during consortium and events, competition, and the crossover of staff (Duke University, n.d.). Many consortiums have cross-town agreements with schools in the local area where MIDN can attend one school for academics while being part of the NROTC unit at another school. This allows MIDN to attend school at over 160 colleges and universities across the country.

The NROTC program today has a variety of different ways to attain a commission. These include, but are not limited to, four-year national scholarship, three-year scholarship, two-year scholarship, nurse scholarship, four-year language, regional expertise and culture (LREC) scholarship, and advanced standing. Basic requirements to be eligible for the program are:

- Be a U.S. Citizen
- Be at least 17 years old not yet 23 by September 1 of the year starting college
- Be younger than 27 by graduation and commissioning
- Be a high school graduate
- Be medically and physically qualified
- Have no moral obligations or personal convictions that prevent conscientious bearing of arms
- Gain admission to an approved Navy ROTC college or university
- Have qualifying SAT or ACT scores (Naval Education Training Command [NETC], n.d.b)

In addition to these basic requirements, applicants are required to select five choices for the college or university they wish to attend. Scholarships, if awarded, are given to one of those five choices. Scholarships can be transferred to a different school with approval from NETC.

MIDN who receive a scholarship not only have their tuition paid for, but also receive a semi-annual book stipend of $325 (NROTC Scholarships, 2020), as well as a monthly stipend. The monthly stipend increases with seniority in the program starting at $250 per month for freshmen and increasing $50 per year to $400 per month for seniors (United States Navy, n.d.). If MIDN are unable to attain a scholarship while in the program, they are eligible for advanced standing which provides a monthly stipend for their last two years of school and a guaranteed commission upon graduation.

To get a return on their investment, NROTC requires MIDN to serve on active duty following graduation and commissioning. This requirement is called the military service obligation (MSO). If the scholarship is activated as a freshman holding a four-year national scholarship, the obligation point begins September 1st of their sophomore year. If the scholarship has been activated at any point after the first year, the obligation point is established on the date it is signed (Naval Education Training Command [NETC], n.d.a).

Although many MIDN join NROTC each year in the hopes of becoming commissioned naval officers, not all who start will finish the program. MIDN who do not commission attrite from the program for a variety of different reasons. Some of these are voluntary and some are involuntary. A MIDN can be involuntarily dropped from the program for the following reasons: academic, physical, disciplinary, inaptitude, and others. A MIDN leaving the program voluntarily is called a drop on request (DOR). Before the obligation point, no repayment is required if the MIDN drops or is disenrolled from the program. If a MIDN drops or is disenrolled after the obligation point, a minimum of two years of active enlistment or repayment of tuition dollars is required.

Upon graduation from their respective college and NROTC program, MIDN are commissioned as officers into the United States Navy and Marine Corps. The MSO for Navy option MIDN is five years of active military service and three years of Inactive Ready Reserve. Additional obligations may be required due to job choice. The MSO for Marine Corps option MIDN is four years of active military service (NETC, n.d.b).

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III. LITERATURE REVIEW

A literature review was completed to aid in the answering of the project's research questions. Attrition studies were reviewed to see not only how many students are dropping out of college before graduation, but why they are dropping out. The increase in college tuition was reviewed to see the rate at which tuition is increasing in the United States, as well as the return on investment the U.S. Navy gets by requiring a MSO. Commissioning cost studies were reviewed to examine different ways of attributing direct, indirect, and overhead costs to each NROTC commission.

A. ATTRITION

The college attrition rate has a significant impact on the cost per commission calculations the Navy performs. The fewer number of MIDN that attrite from the program, the smaller the cost if per commission. The United States has a similar problem with college attrition. Studies by the National Center for Analysis of Longitudinal Data and Education Research and the Bill and Melinda Gates foundation show that approximately 60% of students who enroll in traditional four-year bachelors' degree programs do not graduate within 6 years of starting (Velez, 2014, 1). When asked why those students leave school without finishing, over half of the students who dropped out of school cited cost as the primary reason for leaving (Johnson et al., 2020).

In a 1993 study by Maureen Cahill it was found, that when compared to non-NROTC college dropouts, attrition overall was very similar. It found that 34% of all attrition occurs during the first year in the program before the MSO is required (Cahill, 1993). This rate is consistent with the freshman drop-out rate for non-NROTC students. MIDN dropping out during their freshman year have the biggest impact on cost as there is no requirement for the MIDN to reimburse the Navy for any expenses during that time.

Although lowering attrition is one way to cut costs to the program, it is imperative to know that "There are several reasons why some level of college non-completion is expected. For example, students make their decision to enter college based on limited

information and some students on the margin of college entry may need to experience one year of college to obtain more information" (Velez, 2014, 1).

B. INCREASE IN COLLEGE TUITION

In the United States, the majority of colleges are either private or public. Private colleges are privately funded with most, if not all, of their funding coming from tuition dollars and donations. Public colleges are funded by a mix of federal, state, and local funding as well as tuition dollars and donations (Kerr, 2019).

The cost of college tuition has risen dramatically in recent years. A study from the College Board shows that the average tuition for four-year public colleges and universities has increased at an inflation-adjusted rate of 3.1% from 2008–2018 (College Board, 2018). Although the sticker tuition price for private colleges is nearly three times that of public colleges, the average tuition has only increased at an inflation-adjusted rate of 2.3% (College Board, 2018).

The main reason for the higher rate of tuition increase for public colleges is states pulling back their funding of higher education. During the 2018 school year, states spent on average 13% less than they did in 2008 on higher education funding. When the states reduced on funding for higher education, the cost was passed on to the students in the form of higher tuition.

The Navy gets an ROI on paying for NROTC scholarship MIDN's tuition by requiring an MSO. In the Holloway Plan, the original minimum service obligation was three years of active duty service. This later increased to four years and stayed that way until 2009. NAVADMIN 257/09 was released in September of 2009 and it changed the minimum service obligation from four years to five years. Since this change occurred, public school tuition has increased by 37% with no additional increase in service obligation.

C. CBO OFFICER COMMISSIONING COST STUDY

A study conducted by the Congressional Budget Office assessed the cost of commissioning programs and the performance of the officer post-commissioning. Since

the study looked at all three commissioning sources across the different services, military academies, ROTC, and OCS/OTS, the study did not review the total cost to society, but the direct cost to the DOD. For the NROTC analysis, the study only reviewed the costs for graduates of scholarship programs and did not review the costs for graduates of nonscholarship NROTC programs. As seen in Table 1, the study found that the DOD average cost per ROTC (Scholarship) graduate in 1989 was $53,000. Adjusted for inflation, this comes out to $103,920 in 2018 dollars.

Table 1. DOD Average Cost Per Graduate in 1989 (In dollars). Source: Congressional Budget Office (1990)

	Army	Navy	Air Force
Academy	229,000	153,000	225,000
ROTC (Scholarship)	55,000	53,000	58,000
Officer Candidate School/ Officer Training School	15,000	20,000	18,000

This amount was still significantly lower than an academy graduate at about one-third the price. They found this to be the case for multiple reasons. The most obvious reason is that the NROTC scholarship only, “Pays the cost of all tuition and fees, rather than the full cost of college education that would be financed in part by institutional support from gifts, grants, government aid, and perhaps other sources” (Congressional Budget Office [CBO], 1990). Secondly, NROTC MIDN attend schools that have lower tuition costs than the service academies. Thirdly, the service academies are responsible for non-academic costs for which the colleges and universities are not responsible.

Although this study examined the DOD average cost per graduate, it did not break down the cost by any other factors such as the tuition type of the school attended, type of scholarship each MIDN received, or attrition. This study used the term “ROTC scholarship” for Army, Navy, and Air Force ROTC programs and did not state whether or not the analysis was only for four-year scholarships or if it included shorter scholarships of either three or two years.

D. GAO OFFICER COMMISSIONING COST STUDY

This report by the Government Accountability Office was very similar to the one produced by the Congressional Budget Office. This study was also completed in 1990 but came to a significantly different outcome in terms of the cost of each graduate from the NROTC program. As seen in Table 2, this study attributed direct, indirect, and overhead costs to each graduate and concluded that the cost per graduate of the NROTC program was $126,014 FY 92 (Jones, 1992). Examples of overhead costs in the study include: staff travel, civilian pay, advertising, and support commands. Many of the costs in this study had to be estimated due to the services not operating a uniform, standardized cost reporting system. Units are not required to report specific expenses to higher commands and this makes it extremely difficult to pin down the exact cost of each program. The conclusion of the report stated, "Neither DOD nor the services know either the relative or absolute cost-effectiveness of their various production sources" (Jones, 1992).

Table 2. Major Cost Categories for ROTC FY92. Source: Government Accountability Office (1990)

Dollars in thousands			
Cost categories	**Army**	**Navy**	**Air Force**
Military pay	$202,300	$37,186	$68,964
Civilian pay	20,125	2,853	1,481
Staff travel	5,286	1,464	1,241
Operating expenses	9,085	2,504	2,844
Automation	1,758	455[a]	181
Advertising[b]	10,532	106[c]	1,341
Scholarships[d]	61,542	49,927	30,354
Candidate expenses[e]	44,458	16,518	13,353
Special training[f]	3,185	59	0[g]
Advanced training[h]	0	0	2,172
Support commands[i]	14,241	1,133	2,604
Preparatory school	0[j]	13,809	0[j]
Other	271[k]	0	0
Total	**$372,783**	**$126,014**	**$124,535**

Similar to the report by the CBO, this report did break down the cost of scholarship and non-scholarship NROTC graduates separately. It found that a non-scholarship NROTC graduate costs approximately 45% less to produce than a scholarship graduate. It used the term "scholarship student" generally to refer to any MIDN on a four-year, three-year, or two-year NROTC scholarship. This study did not look into the types of scholarships

awarded or to what schools those scholarships were given. It found the average cost per graduate while not attributing average overhead costs. It did not go into detail in different school types.

E. SUMMARY

This thesis is closely aligned with the CBO commissioning cost study. Given that the CBO completed their study using direct cost, this thesis also uses direct cost as all other costs were too vague for accurate estimations. Expanding upon this, this thesis breaks down the commissioning cost by school tuition regime. The intent is to give a more detailed cost per commission number for four-year scholarship MIDN.

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IV. DATA, METHODOLOGY, AND ANALYSIS

This chapter explains how the data set was filtered to analyze 4-year scholarship students from 2009–2019. It looks into the costs associated with the program as well as how the cost of each MIDN was calculated. It then analyzes the cost per commission for each school tuition type and describes the model created for NETC to optimize NROTC four-year national scholarship MIDN school placement. It is broken down into the four following sections: Data, Structuring the Data, Analysis, and Model.

A. DATA

The data set in this project was provided by NETC. The file contains individual-level data (categories of variables) on all MIDN who reported into the program between 2009 and 2019. MIDN participating as both Navy and Marine Corps options are represented in the data set.

1. Data Set Variables

Each MIDN had the following categories attached to their line of data: program code description, naval science year, date reported, estimated commissioning date, date attrited, attrite category, and tuition type.

Program code description referred to the type of scholarship awarded to the MIDN. The most prevalent of these in the original data set were four-year national scholarship, three-year scholarship, two-year scholarship, nurse scholarship, four-year LREC, and college program two-year. To stay within the scope of this project, only four-year scholarship MIDN were looked at in this thesis.

Naval science year referred to the MIDN's year in the program. This number was also a good approximation as to how much the Navy has paid for that MIDN. MIDN who have commissioned from the program are in their fourth or fifth naval science year while MIDN who attrite from the program are in any naval science year. Table 3 shows the naval science year in reference to the MIDN's college year.

Table 3. Naval Science Year

Naval Science Year	College Year
1	freshman
2	sophomore
3	junior
4	senior
5	fifth-year senior

Date Reported referred to the date when the MIDN entered the program. This period was from 2009–2016.

Estimated Commissioning Date referred to the year in which the MIDN was expected to commission. This range for this is 2012–2019

Date Attrited referred to the date when the MIDN left the program. Although the category is attrite, it also includes commissions. For example, if a MIDN commissions after their 4th naval science year, the MIDN's date attrited will reflect that they attrited from the program on their commissioning date. The attrite category will say commission. The range for this variable is 2012 - 2019.

The time variables with their associated years in Table 4.

Table 4. Time Variables

Time Variables	Years Constrained
Date Reported	2009-2016
Estimated Commissioning Date	2012-2019
Date Attrited	2012-2019

Attrite Category referred to commission, academic, disciplinary, drop on request, inaptitude, physical, and other. For the purpose of this analysis, the MIDN who attrite from the program includes all Attrite Category variables except for commission.

Tuition Type referred to the tuition regime of the school the MIDN attended. The three options for this were PIS, POS, and PRI.

2. Proxy Variables

Due to the limited specificity of time in the program, several proxy variables were created to determine the length of time each MIDN spent under scholarship. The data had both a date reported and a date attrited. It was assumed that the MIDN was under scholarship during that period. This resulting variable was *years under scholarship*. The variable was defined by rounding up to the nearest half integer to represent semesters in college. College tuition, on average, is paid by the semester.

Annual tuition and fees cost were taken from the U.S. Department of Education's National Center for Education Statistics. The tuition is for four-year PIS, POS, and PRI colleges and universities. The average annual tuition used for this thesis is represented in Table 5. Each year of tuition was adjusted to FY18 dollars using CPI indices from the U.S. Census Bureau which can be seen in Table 6. Using average costing, the tuition was averaged for each tuition regime between 2009 and 2019. Table 7 shows the average tuition cost per year for PIS, POS, and PRI colleges and universities in FY18 dollars.

Table 5. Tuition Cost Per Year (Current Year Dollars). Source: National Center for Education Statistics (n.d.)

Year	PIS	POS	PRI
2009	$6,695	$18,451	$23,210
2010	$7,136	$19,622	$22,771
2011	$7,701	$20,609	$23,479
2012	$8,070	$21,847	$24,525
2013	$8,312	$22,603	$25,696
2014	$8,543	$23,523	$26,740
2015	$8,778	$24,354	$27,951
2016	$8,804	$24,854	$29,478
2017	$9,037	$25,657	$30,731
2018	$9,212	$26,382	$31,875

Table 6. CPI Inflation Indices. Source: United States Census Bureau (2020)

Year	CPI-U-RS Index
2009	315.2
2010	320.4
2011	330.5
2012	337.5
2013	342.5
2014	348.3
2015	348.9
2016	353.4
2017	361.0
2018	369.8

Table 7. Average Tuition Cost Per Year (FY18). Adapted from National Center for Education Statistics (n.d.)

School Tuition Type	Tuition Cost Per Year
PIS	$8,858
POS	$24,516
PRI	$28,662

The annual book stipend was $750 for each MIDN. This does not change based on the MIDN's time in the program. The annual monthly stipend was tied to the amount of time the MIDN had spent in the program. Table 8 shows the MIDN's monthly stipend in relation to their school year. MIDN received this pay for approximately 10 months out of the year. The annual monthly stipend was calculated by adding up the four levels of payments then dividing them by 4 to get an average monthly stipend. This amount was multiplied by 10 months to get an annual monthly stipend of $3,250. Book and monthly stipends were not adjusted for inflation as they stayed the same during the time analyzed in this project.

Table 8. Monthly MIDN Stipend. Source: United States Navy (n.d.)

School Year	Amount
Freshman	$250
Sophomore	$300
Junior	$350
Senior+	$400

B. STRUCTURING THE DATA

The way the data was collected, each MIDN was reported twice per year. A MIDN that completed NROTC in four years and commissioned appeared eight times in the data set. The data set needed to be reduced so that there was only one entry per MIDN who entered the program between 2009 and 2019 while ensuring that the entry had the attrition category attached to it.

ENS Zach Swenson assisted with filtering the data using the programming language R. ENS Swenson read the CSV file that was sent from NETC into R to create a data frame that contained 117,787 entries. All of the data entries that did not have data entered in the date attrited category were removed as only the individuals who had either attrited or commissioned from the program were relevant to this study. Then, using the distinct function, all of the repeat Student ID numbers were removed so that there was only one observation per student ID if they attrited or commissioned from the program. That reduced the data set down to 18,313 entries.

Exporting this file into Excel, the data was filtered down further to fit into the constraints of the analysis. Using the data filter function, four-year national scholarship MIDN were selected reducing the data set down to 8,255 entries. Estimated commissioning and date attrited were constrained to 2012–2019 reducing the data set down further to 7,109 entries. Lastly, the date reported was constrained to 2009–2016 reducing the data set to 6,981 entries. The tuition types were filtered down separately and PIS, POS, and PRI tuition had 2,433, 2,144, and 2,404 entries respectively.

Once there was only one entry per MIDN in the program, the amount of time the MIDN spent in the program had to be calculated. Date reported and date attrited were in the data set, but this had to be manipulated to show the amount of time under scholarship

in increments of half years, i.e., a semester. This variable *ceiling years under scholarship* (CYUS), was created by adding three columns to the data set. The columns were days under scholarship (DUS), years under scholarship (YUS), and ceiling years under scholarship (CYUS). DUS was calculated by subtracting the date attrited cell by the date reported cell.

$$DUS = \text{Date Attrited} - \text{Date Reported}$$

The result was then divided by 365 days (1 year) to get years under scholarship.

$$YUS = DUS/365 \text{ days}$$

Since the majority of schools are on a semester tuition system, the years under scholarship had to end in a whole number or half way between whole numbers. This was found by the ceiling function, the "years under scholarship" cell, with a significance of 0.5.

$$CYUS = \text{Ceiling}(\text{YUS}, 0.5)$$

Total cost for each MIDN was determined by multiplying CYUS by the annual book stipend, annual monthly stipend, and the tuition cost. Tuition cost was broken up into three columns. The three columns represented PIS tuition paid, POS tuition paid, and PRI tuition paid. Using the *if function*, two of the columns resulted in $0 paid, while the third column showed the tuition paid. This amount, added together with the amount paid for books and the annual monthly stipend, equaled the total cost paid for that MIDN.

All of the costs for each MIDN were then added together to compute a total cost of the program for the four-year national scholarship MIDN who reported between 2009–2016. Out of the total number of MIDN in the data set the number who actually commissioned and became naval officers needed to be calculated. This was found using a *countif function* in the *attrite category* column, counting the number of times the *attrite category* was "commission." The total cost of the entire program found earlier was then divided by the number of MIDN who commissioned. This result was the cost per commission.

This entire process was done three additional times. The data set was split into three parts based on the MIDN's tuition category. This resulted in a cost per commission and attrition rate for each tuition category.

C. ANALYSIS

Table 9 presents the cost per commission and attrition rate of NROTC MIDN who reported on a four-year national scholarship between 2009 and 2016. The overall direct cost to the Navy for this group was approximately $630 million dollars with an average cost per commission (CPC) of $67,300. Out of the 6,981 total MIDN, approximately one third went to PIS schools, one third went to POS schools, and one third went to PRI schools. Once the group was split up into the three tuition categories, the cost per commission varied widely.

As seen in Table 9, PIS CPC was shown to be significantly cheaper than POS or PRI at $64,571. POS and PRI CPC were over twice the cost of PIS at $140,871 and $155,595 respectively.

Table 9. NROTC Cost per Commission. Adapted from NETC (2020)

	Average of PIS, POS, and PRI	Public In-state (PIS)	Public Out-of-state (POS)	Private (PRI)
Total Number of Students	6981	2433	2144	2404
Number of Commissioned Students	5227	1740	1628	1859
Total Cost	$ 630,943,295	$ 112,354,267	$ 229,337,686	$ 289,251,341
Cost per Commision	$ 120,708	$ 64,571	$ 140,871	$ 155,595
Attrition Rate	25%	28%	24%	23%

Twenty-five percent of the 6,981 MIDN who started the program attrited before commissioning. This is significantly less than the 60% of the general population of students who fail to finish a four-year bachelor's degree within six years. The attrition rate decreased slightly compared to the CPC of each school type. PIS had a 28% attrition, while only 23% of PRI MIDN attrited the program.

D. MODEL

A linear programming model using Excel was created to optimize money spent on four-year national scholarship MIDN. The model shown in Table 10 includes decision variables, constraints, and an objective function.

Table 10. Programming Model Example

Decision Variables	Public In-state	Public Out-of-state	Private	Total			
	29	21	33	83			
% of Total	35%	25%	40%	100%			
Cost/Commission	$ 64,571	$ 140,871	$ 155,595				
Constraints				Used		Allowed	% of Total
Budget	1	1	1	$ 10,000,000	<=	$ 10,000,000	
Public In-state	1			29.15	>=	24.99	0.3
Public In-state	1			29.15	<=	58.31	0.7
Public Out-of-state		1		20.82	>=	20.82	0.25
Public Out-of-state		1		20.82	<=	62.47	0.75
Private			1	33.32	>=	33.32	0.4
Private			1	33.32	<=	49.98	0.6

This model allows NETC to maximize the number of commissions given a budgetary constraint as well as constraining the number of MIDN who attend each type of school. The example in Table 10 uses $10,000,000 as the budgetary constraint. MIDN who attend PIS are constrained between 30% and 70%, those who attend POS are constrained between 25% and 75%, and those who attend PRI are constrained between 40% and 60%. The constraints were chosen as they are within the current split of one-third between the three tuition types, while also allowing the model to have the flexibility to optimize. The model found that in order to maximize the number of commissioned officers while staying within the constraints, 29 MIDN should attend PIS, 21 should attend POS, and 33 should attend PRI for a total number of 83 commissions.

The results are plausible when taking a step back and thinking of the model in broad terms. The model is trying to maximize the number of MIDN in the program. Since the cost per commission of PRI and POS compared to PIS is significantly higher, PRI and POS MIDN will be minimized to the fullest extent of the constraint while PIS will be

maximized. The minimum constraint for PRI and POS were 25% and 40% respectively. This leaves 35% left to be allocated to PIS where the model is trying to maximize since PIS cost the least out of the three decision variables.

The model can easily be adjusted to reflect the goals of NETC. The budgetary constraint under "allowed" can be increased or decreased based on the direction of the NETC budget. The constraints for the tuition type can all be adjusted to reflect the type of school diversity NETC is looking for at the time. If they have a larger budget but are expected to commission less MIDN, they can allocate more MIDN to PRI schools. The reverse can happen if they have a small budget and need more commissions.

E. SUMMARY

This chapter covered the results of the study on the NROTC Cost Per Commission. The findings are limited to four-year scholarship MIDN who reported into the program between 2009 and 2016. The three direct costs attributed to each MIDN were school tuition, MIDN monthly stipend, and the annual book stipend. Using the time in the program, the cost per MIDN was calculated. Once attrition rates were determined, the CPC for each type of school tuition was calculated. The study found that attrition for the four-year program at 25% was significantly less than the attrition for the general public's four-year bachelor's degree attrition which is 60%. Attrition for each school tuition type was found to be slightly different with the PIS having attrition at 28% and falling to 23% at PRI schools. Although attrition was higher for PIS schools, the cost of tuition was significantly more important for looking at the cost per commission. PIS CPC was less than half of POS or PRI CPC.

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V. CONCLUSIONS AND RECOMMENDATIONS

A. CONCLUSIONS

The current NROTC application process allows for high school students to apply to any college or university that has a NROTC program. Scholarships are allocated to each school but can easily be transferred between schools with prior NETC permission. For the first research question, "What are the main costs to the Navy, per officer commissioned?" the main findings were that the Navy pays directly for a MIDN's college tuition, a monthly stipend, and an annual book stipend. All other costs are either indirect costs or overhead costs and the Navy's current accounting system does not allow for these costs to be estimated as they vary significantly from NROTC unit to NROTC unit. The average NROTC cost per commission of a naval officer was calculated to be $120,708 (FY18).

For the second research question, "How do these costs vary by type of school attended?" it was found that on average, the Navy pays more than three times as much for MIDN who attend POS or PRI school than those MIDN who attend PIS school. For MIDN who reported to NROTC between 2009 and 2016, one third went to schools with PIS tuition, one third to schools with POS tuition, and one third to schools with PRI tuition. Cost per commission rose with the increase in tuition price with PIS tuition being less than half of POS and/or PRI tuition.

For the third research question, "How does attrition in NROTC vary by the type of school attended, PIS, POS, or PRI?" found that attrition is roughly the same between each tuition type, at roughly 25% of all four-year national scholarship MIDN. Because the attrition is approximately the same, the cost per commission is tied closely to the tuition of each school. When the three types of schools were split up, this study found that attrition was only slightly different. PIS attrition was 28%, POS was 24%, and PRI was 23%.

The model created allows NETC to support decision making on cost reductions within the command. The user is able to change the budgetary constraint to reflect the increase or decrease in funding. The percentage of PIS, POS, and PRI MIDN can be adjusted to meet either a number of commissions requirement based on a budgetary

constraint, or to increase diversity among school tuition types if the budgetary constraint is not a factor.

B. FURTHER STUDY RECOMMENDATIONS

Further research on this subject should look at the CPC of individual year group between 2009 and 2016. More detailed analysis of each year group would allow NETC to better understand how MIDN react to certain external factors that cannot be assessed while analyzing the MIDN from 2009 to 2016 as a whole.

A second recommendation for further studies is to look at, either individually or together, three-year and two-year scholarships. The process for applying for these scholarships is significantly different than the four-year scholarship as MIDN are already attending school and are in the NROTC program as non-scholarship participants. When prospective MIDN apply for the three-year or two-year scholarship, the scholarship is tied to the school that they are currently attending and is not easily transferable. Looking at this would be beneficial to see how much cost savings could be had from reducing the length of scholarship awarded.

A final recommendation is to complete a sensitivity analysis on the awarding of four-year scholarships to a specific tuition type school. For example, applicants to the program may receive a scholarship to a PIS school but choose to attend a POS school as a civilian. Would the MIDN take the NROTC scholarship if they were awarded it to the school of their choice? An analysis of this was beyond the scope of the project and therefore was not researched.

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